

THE DYNAMICS IN CHANNEL SHIFT OF THE BRAHMPUTRA ALONG THE AGYATHURI-SUALKUCHI AREA OF KAMRUP DISTRICT, ASSAM

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Abstract

Since ages people and rivers have been closely associated with and a slight change in behavior in any aspect has serious repercussions upon the other. Brahmaputra-the lifeline of about 264 lakh population of Assam, has been intrinsically related with the way of life of the inhabitants within its domain and has both positively and negatively affected them. Bank line migration and consequent channel shift is a common phenomena of the mighty river due to its high braided condition and host of other geological as well as other hydrological factors. The study incorporates the Agyathuri-Sualkuchi stretch of Kamrup district, within 5 kms downstream of the Saraighat bridge (the first bridge over Brahmaputra), where the river shows strong northward migrating tendency. Major changes and displacements have been taking place in the region due to channel shift. Keeping in view all these aspects, the paper tries to examine the extent of area encroached by the river since 1911 to 2005 and thereby analyse the causes responsible for channel shift. The specified objectives have been fulfilled based on the utilization of toposheets and google maps in GIS environment including personal field visit. Necessary maps and diagrams have been prepared for exposition of the problem.

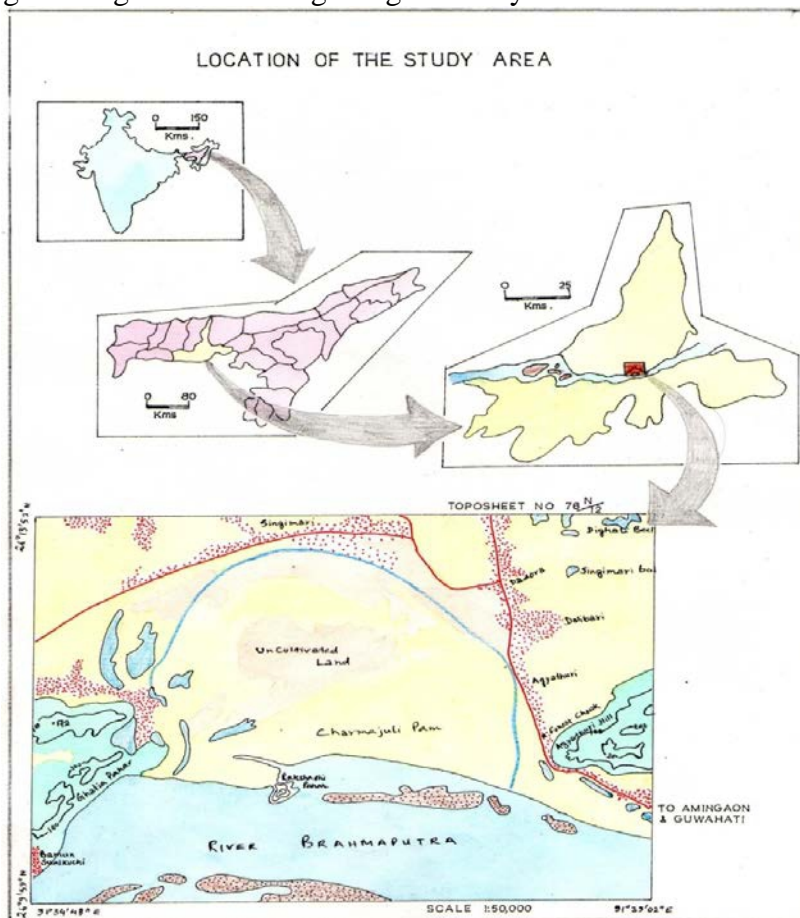
Keywords: Bank line migration, Braiding, Depopulation, Deposition, Displacement, Erosion

Introduction

Rivers are dynamic and thus through the process of erosion, transportation and deposition produces dynamic landforms all along its course. However the natural flow of the river is sometimes interrupted by human activities which further accelerates the dynamism of the as well as the consequent landforms. Brahmaputra-the second largest river in terms of

sediment transport and well reputed for its braided condition, has well developed and ever developing both erosional and depositional features associated with it. Extensive erosion in some reaches and deposition in some other reaches is a common phenomena of the river, however this common behavior tends to bring uncommon change in the way of life of the people living on its bank.

The study area i.e. Amingaon-Sualkuchi stretch from the Saraighat bridge to 5kms downstream, extends from roughly $91^{\circ}30'$ to $91^{\circ}40'$ East longitude and latitudinally it extends from $26^{\circ}10'$ to $26^{\circ}15'$ North. The area is surrounded by Agyathuri hills (387 m) in the East, Ghatia Pahar (172 m) in the West, Singimari-Sualkuchi road in the North and Sadillapur and Garigaon Hindu village in the south. The area has been chosen for study as the region shows interesting pattern of bank migration due to the controlling aspects of the Agyathuri and Ghatia Pahar in the east and west respectively. The northern flank being a plain tract and devoid of any natural or man-made obstacle is more susceptible to bank migration. Therefore the river is showing a strong northward migrating tendency here.



Objectives

The main objectives of the study includes-

- (a) To examine the extent of bank-line migration of the Brahmaputra in Agyathuri-Sualkuchi region from 1911 to 2005 and
- (b) To analyze the underlying factors responsible for channel shift.

Methodology of the study

For the purpose of accessing the extent of bank erosion, toposheets dating to 1911(78N/12) and 1968-72(78N/12) and a Google map of the particular area pertaining to the time period Oct, 2004- Feb, 2005, has been collected. The toposheets were converted into soft copy and utilized in GIS environment for georeferencing. Then the required shape files have been made for digitization and thus different layers have been created. Lastly these layers have been merged together through overlay technique for determination of the shifting pattern of the river bank. Similarly areas eroded and deposited have been computed out. Necessary maps and diagrams have also been prepared for clear exposition of the problem. In addition personal field visit (both in pre-monsoon, monsoon and post-monsoon period) has been done for perceiving the extent of damage done to the local inhabitants. Some elderly members of the river bank villages have been investigated for understanding the pattern of channel dynamics after the great 1950 earthquake.

Analysis and Discussion

Extent and Nature of Bank-line migration of Brahmaputra in the study region:

Bank-line migration is a direct consequence of interactions and interrelationships between various aspects like extent of river activities (erosion, transportation and deposition), volume of river water during peak season, soil and geological structure including mass human interference with the river. Similarly is the case with Agyathuri-Sualkuchi region, where the main controlling factors of channel migration being seismicity, soil, rigid rock structure (Agyathuri hills and Ghatia Pahar) and human interference in the form of construction of the Saraighat Bridge and earth cutting.

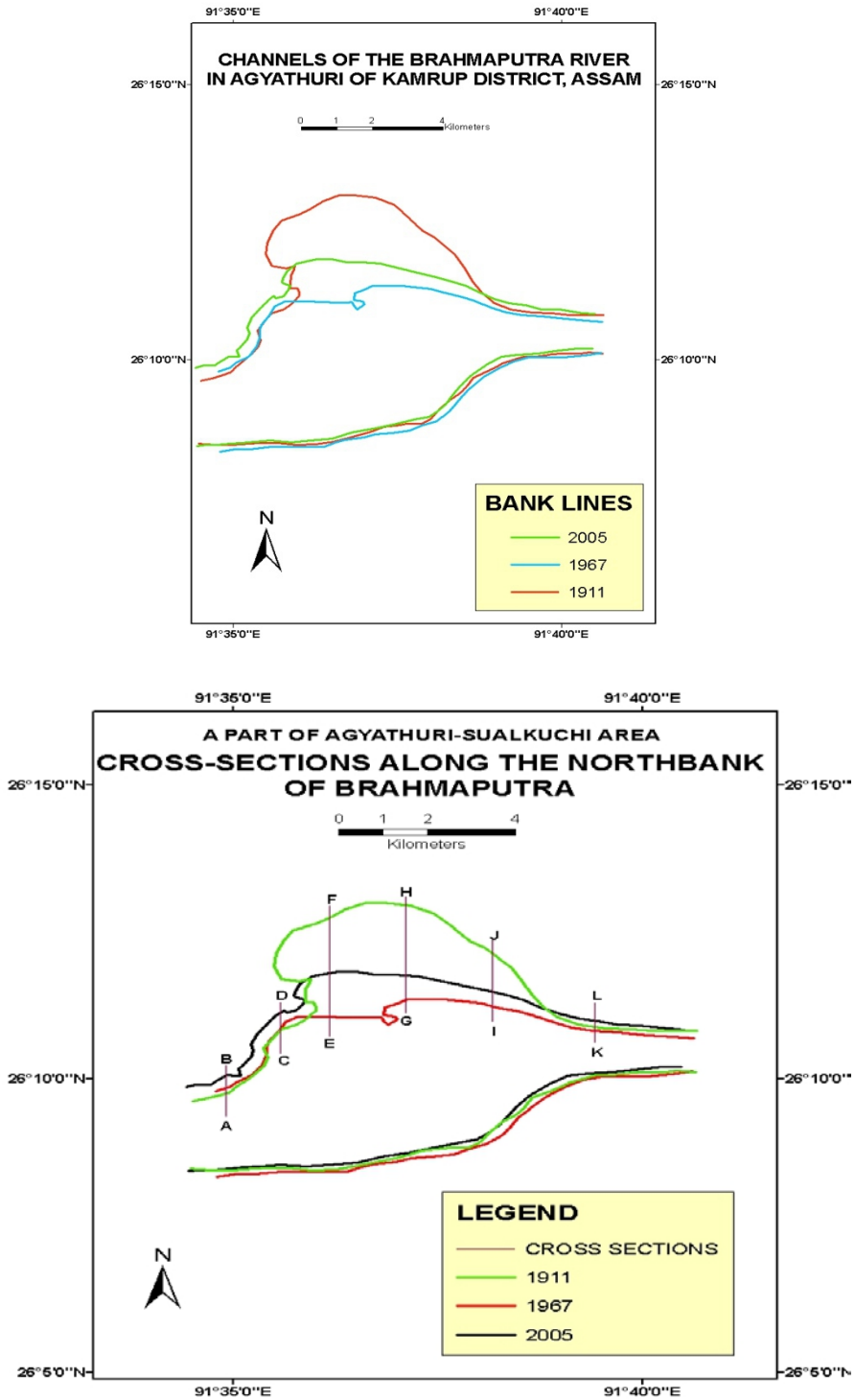


Table 1: Bank line Migration of the Brahmaputra along Agyathuri-Sualkuchi region, 1911-2005

| <i>Cross-Section</i> | <i>Year</i> | <i>Bank line shift (in meters)</i> | <i>Direction of shift</i> | <i>Distance from Saraighat Bridge(in kms.)</i> |
|----------------------|-------------|------------------------------------|---------------------------|--|
| AB | 1911-1967 | 210 | South-North | 11.0 |
| | 1911-2005 | 610 | South-North | |
| | 1967-2005 | 400 | South-North | |
| CD | 1911-1967 | 100 | South-North | 9.2 |
| | 1911-2005 | 610 | South-North | |
| | 1967-2005 | 510 | South-North | |
| EF | 1911-1967 | 3070 | North-South | 8.4 |
| | 1911-2005 | 1700 | North-South | |
| | 1967-2005 | 1370 | South-North | |
| GH | 1911-1967 | 3000 | North-South | 6.6 |
| | 1911-2005 | 2180 | North-South | |
| | 1967-2005 | 820 | South-North | |
| IJ | 1911-1967 | 1680 | North-South | 4.5 |
| | 1911-2005 | 1220 | North-South | |
| | 1967-2005 | 460 | South-North | |
| KL | 1911-1967 | 120 | North-South | 2.0 |
| | 1911-2005 | 210 | South-North | |
| | 1967-2005 | 340 | South-North | |

The extent of erosion in the proposed region has been measured at different cross-sections, from west to east along the north-bank of the Brahmaputra from Saraighat Bridge to 11kms downstream. A study of the Toposheets and Google images, pertaining to three different years (1911, 1967 and 2005) reveals that the north bank is highly unstable and is extremely susceptible to bank erosion. However in comparison to the north bank, the south bank is comparatively stable.

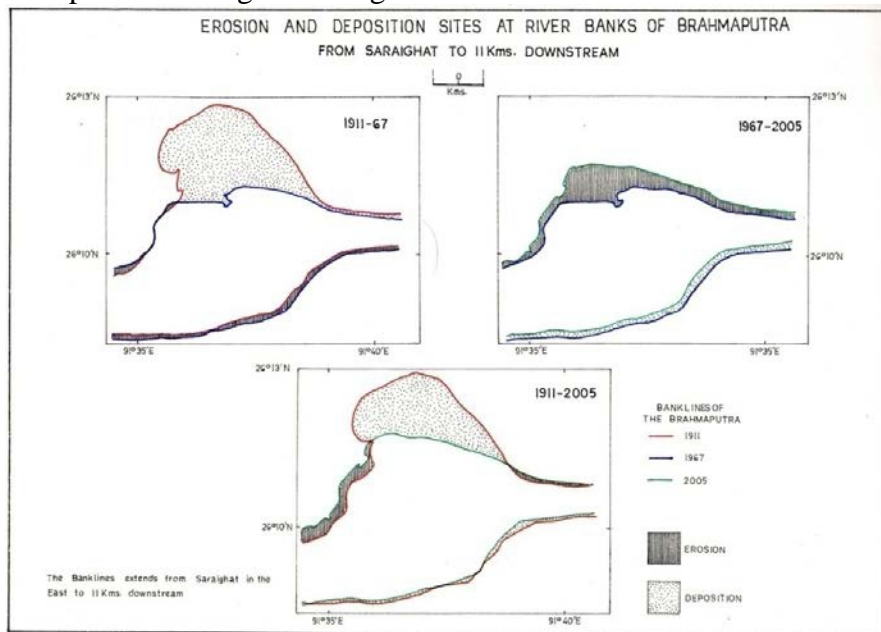
Although erosion and northward channel shift is common in north bank but it is not so as alterations and modulations in the controlling factors (structure, process and stage as envisaged by Davis) of the dynamic river tend to bring dynamism in the resultant landforms. Along the cross section AB (Table 1), the bank shift is generally from south to north for all the concerned years. But the cross-section EF reveals a completely different scenario. During the year 1911-67, the channel shifted from north to south (along the north bank) and so is the bank-line of the year 1911-2005. But during the year 1967-2005, the shift was from south to north direction. This clearly reveals that during the year 1911-67, there was extensive deposition along the north bank, whereas the process of erosion dominated the scene during 1967-2005. It is noteworthy that the bank shift along the north bank is highest along the EF cross-section where during the year 1911-1967, there was southward shifting of the bank to about 3.07kms(Table 2).

Table 2: Erosion and Deposition of Sediments by the Brahmaputra in the Study Region, 1911-2011

| Year | Bank | Erosion (sq. m) | Deposition (sq. m) | Remarks |
|-----------|------------|-----------------|--------------------|---|
| 1911-2005 | North Bank | 2,170 | 12,100 | Within 11kms from Saraighat Bridge downstream |
| | South Bank | ----- | 3,200 | |
| 1911-1967 | North Bank | 700 | 19,800 | |
| | South Bank | ----- | 4,100 | |
| 1967-2005 | North Bank | 10,500 | ----- | |
| | South Bank | ----- | 6,300 | |

Extensive bank erosion in the north has led to varying magnitude in both erosional and depositional process. During the year 1911-2005, the eroded area in the north bank corresponds to 2.17sq.km whereas from 1967-2005, it surged to 10.5 sq.km. Thus due to erosion, much fertile agricultural land has been lost. Among the villages, the most highly affected are No.1 Gondhmow and No.2 Dolibari. The extent of damage of these two villages can be gauged from the fact that their respective total area of 6.33 and 5.70 sq.km during 1971 decreased to 2.33 and 2.97 sq.km in 1991 and is further on a decreasing line.

However where there is erosion, there exist deposition too. From 1911 to 2005, the deposited area along the north bank is 12.1sq.km whereas the south bank which is relatively stable experienced 3.2 sq.km of deposition. The stable nature of the south bank can be attributed to the bank protection measures that have been taken up on this side of the river (Ojha et.al, 2004). Anti-erosion measures like boulder pitching and land-spur have been adopted in the region during the mid 1970's and 1980's itself.



Causes of Channel Shift

A vibrant and energetic river like the Brahmaputra has apparent propensity to fiddle with its path, based on topography, altitude, slope and other uniform or catastrophic phenomena-be it natural or anthropogenic. Various morphological landforms have been studded all along the course of the Brahmaputra which depicts its dynamism and its adjustment with time. A braided river like the Brahmaputra carrying a large load of sediments and flowing over a flat terrain with easily erodible soil is marked by great instability of its channel (Coleman, 1967). The main causes of bank-line migration in the proposed study region include high overflow of water and consequent sediment discharge during rainy season, lateral movement of water level including toe-erosion, non-cohesive loose soil composition, width differential of the river, high seismicity, earth cutting etc.

During summer season, the whole of the Brahmaputra valley receives more than 250 cm of average rainfall, due to which the level of water in the mighty river as well as sediment discharge increases to a great extent. In fact as regards water discharge and sediment transport, the river ranks fourth and second respectively in the world. High water discharge and sediment load has rendered the river a high braiding character with development of many large and small char lands. Thus due to excessive supply of water and sediments, the carrying capacity of the river decreases due to which there is persistent change in its course.

Moreover with change in season, there is constant change in the level of water in the Brahmaputra due to which bank erosion starts. When the whole area is inundated by river water, erosion of the banks is minimum, whereas active erosion in the form of slumping dominates during the receding water level period (October-November)

In addition during low flow stage of the river, the underlying less cohesive soil of the bank gets eroded (toe-erosion) and as a consequence, the baseless bank collapses under the force of gravity.

Besides the narrowness of the Brahmaputra (about 1.4 km) near Jalukbari-Amingaon area due to the presence of the rigid rock masses of Nilachal hills in the south and Agyathuri hills in the north, leads to accumulation of water in its constricted neck, as a result of which the speed of the water current increases downstream. After crossing this narrow reach, the width of the river broadens to about 6 km leading to sluggish flow of water and consequent mass deposition of sediments and formation of sandbars and char lands thereby making the river more braided. In fact a permanent char land, about 5 kms downstream from the Saraighat Bridge, have been formed which is about 12 sq.km in area, where vegetable in large scale is grown by the local inhabitants.

High seismicity is another cause of bank line migration in the area. The whole of Assam including the study region falls in the most active seismic zone (Zone V). Indeed the region experienced two devastating earthquakes in 1897 and 1950 at the Richter scale of 8.2 and 8.7 respectively which brought drastic channel changes in the river all throughout its course. On top of these, the physiography of the region studded with many lakes, swamps and wetlands make the region flood prone and subsequent erosion.

Similarly earth cutting in winter season basically by the inhabitants of Choudhury village and its adjoining areas including lack of any artificial measures unlike the south bank are other important causes of bank line shift. The earth suppliers cut off the bank soil to cater to the needs of construction of the ever growing Guwahati city and thus render the region more exposed to erosion. Furthermore the lack of any artificial structural anti-erosional measures in the north bank aggravates the bank erosion and river migration.

Conclusion

There exist no doubt that the long constant process of flooding in the region has been contributing towards enriching the fertility of the soil and ecological nourishment of the nearby wetlands. But the looming chaos of persistent erosion and degradation of the fertile agricultural and built up land has drastic impact upon the demography, economy, land-use, settlement as well as agricultural pattern of the region. Depopulation and displacement of the nearby village population is a common phenomenon. In fact No. 2 Dolibari (one of the river bank village) registered a negative population growth rate of 23.25 per cent during 1911 to 2011. This in turn has led to change in the settlement pattern where compact settlements tend to develop in uplands and linear settlements besides transport networks. However there has been a long tradition of adaptation to the flood situation in the whole of the state. But the constant northward migration of the river has made the question of adjustment nearly impossible. Thus artificial measures in the form of boulder pitching, bamboo spurs, sand bunds must be adopted as soon as possible. In addition, deepening of channels and removal of sand bars in a regular basis will also go a long way in solving the menace of erosion and bank line migration in the region.

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Some photos of bank erosion in the study area



